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US 5240645 A

US 4678602 A

US 3632792 A

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(54) Abstract Title

**Electrically conductive polymer composition**

(57) An electrically conductive composition comprises a polymeric material and a plurality of metal fibres dispersed within the polymeric material, the polymeric material comprising 30% to 75% by weight of the composition, and the metal fibres comprising 25% to 70% by weight of the composition. The composition may be used to produce moulded electrically conductive polymeric articles, to prevent electrostatic discharges or to earth electrical devices.

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Electrically Conductive Composition

The present invention relates to electrically conductive compositions, and to their use to prevent electrostatic discharges and to earth electrical devices.

It is known to incorporate metal fibres into polymeric materials in order to provide a degree of electrical conductivity to the material. However, the proportion of metal fibres in the polymeric material tends to be small, and typically of the order to 2% by weight of the composition, and no more than 15% by weight of the composition (based upon the total weight of the polymeric material and the metal fibres).

According to a first aspect, the present invention provides an electrically conductive composition comprising a polymeric material and a plurality of metal fibres dispersed within the polymeric material, the polymeric material comprising 30% to 75% by weight of the composition, and the metal fibres comprising 25% to 70% by weight of the composition, based upon the total weight of the polymeric material and the metal fibres.

According to a second aspect, the invention provides an article formed from an electrically conductive composition according to the first aspect of the invention. Preferably the article is a moulded article.

According to a third aspect, the invention provides the use of a composition according to the first aspect of the invention, or an article according to the second aspect of the invention, for preventing electrostatic discharges.

According to a fourth aspect, the invention provides the use of a composition according to the first aspect of the invention, or an article

according to the second aspect of the invention, for providing an electrical connection in order to earth an electrical device.

The inventor of the present invention has surprisingly found that by using a high proportion of metal fibres, i.e. in the range 25% to 70% by weight based upon the total weight of the metal fibres and the polymeric material, a highly electrically conductive polymer material which retains its structural integrity and mouldability may be formed.

A preferred compositional range is 30% to 60%, more preferably 40% to 55%, for example approximately 50%, by weight of the metal fibres based upon the total weight of the metal fibres and the polymeric material.

The inventor has found that the composition according to the invention conducts an electrical current when a low voltage (i.e. less than 100 volts, preferably less than 20 volts) is applied across the composition. For example, a sample moulding in the form of a substantially square cross-section block with dimensions 90 mm x 90 mm x 1.5 mm was electrically tested by applying a potential difference of 9 volts across one of the long dimensions of the moulding (i.e. a distance of 90 mm) and was found to draw a current of 0.16 amperes. An electrical resistance measurement carried out by placing an ohm meter test probe on an external surface of the sample moulding recorded a resistance of 0.001 mV.

The metal fibres preferably comprise steel fibres, and more preferably they comprise stainless steel fibres.

The metal fibres each have a length preferably in the range 2 mm to 20 mm, more preferably in the range 3 mm to 10 mm, for example 4, 5 or 6 mm.

Preferably the metal fibres each have a diameter in the range 4  $\mu\text{m}$  to 30  $\mu\text{m}$ , more preferably in the range 6  $\mu\text{m}$  to 15  $\mu\text{m}$ , for example 8  $\mu\text{m}$  or 11

µm.

The polymeric material preferably comprises a thermoplastic material. Alternatively, however, the polymeric material may comprise a thermosetting material.

Advantageously, the polymeric material may comprise a polyolefin and/or a polystyrene and/or a polyvinyl material. The polymeric material may, in fact, comprise a mixture of two or more different polymers. An especially preferred polymeric material is polypropylene.

Articles according to the invention preferably are made by mixing pellets or granules (or the like) of the polymeric material with the metal fibres, and heating the pellets or granules until the polymeric material melts. The molten composition preferably is processed, for example by moulding it into the desired shape, and/or by extruding the composition, and/or by any other polymer processing technique.

A particularly preferred electrically conductive article in accordance with the invention comprises a furniture component or a room partitioning component for preventing electrostatic discharges from furniture or room partitions. For example, the article may be a cap suitable for mounting on an end of a metal post (or the like) such that metal partitioning panels mounted on the post are electrically connected to each other. By the use of such electrically conductive caps, the panels may be earthed, thereby preventing electrostatic discharges.

Other preferred electrically conductive articles according to the invention include automotive components, for example lamp fittings, radios etc, and any other components which are required to be earthed. Forming the housing of such components from the electrically conductive composition according to the invention provides a simple means for earthing the

components. In fact, the invention is generally applicable to substantially any electrical device which requires earthing.

Another use for the invention is to form polymeric articles from the electrically conductive composition, where such articles require painting and the article would normally require a conductive coating in order to make an electrical connection with the article to facilitate paint spraying of the article. By using an electrically conductive composition in accordance with the invention, an additional conductive coating is not required.

Claims

1. An electrically conductive composition comprising a polymeric material and a plurality of metal fibres dispersed within the polymeric material, the polymeric material comprising 30% to 75% by weight of the composition, and the metal fibres comprising 25% to 70% by weight of the composition, based upon the total weight of the polymeric material and the metal fibres.
2. A composition according to Claim 1, in which the metal fibres comprise steel fibres.
3. A composition according to Claim 2, in which the metal fibres comprise stainless steel fibres.
4. A composition according to any preceding claim, in which the metal fibres each have a length in the range 2 mm to 20 mm.
5. A composition according to Claim 4, in which the metal fibres each have a length in the range 3 mm to 10 mm.
6. A composition according to any preceding claim, in which the metal fibres each have a diameter in the range 4  $\mu\text{m}$  to 30  $\mu\text{m}$ .
7. A composition according to claim 6, in which the metal fibres each have a diameter in the range 6  $\mu\text{m}$  to 15  $\mu\text{m}$ .
8. A composition according to any preceding claim, in which the polymeric material comprises a thermoplastic material.
9. A composition according to any preceding claim, in which the polymeric material comprises a thermosetting material.

10. A composition according to any preceding claim, in which the polymeric material comprises a polyolefin and/or a polystyrene and/or a polyvinyl material.
11. An article formed from an electrically conductive composition according to any preceding claim.
12. An article according to Claim 11, which is a moulded article.
13. An article according to Claim 11 or Claim 12, which comprises a furniture component or a room partitioning component for preventing electrostatic discharges from furniture or room partitions.
13. The use of a composition or article according to any preceding claim, for preventing electrostatic discharges.
14. The use of a composition or article according to any preceding claim, for providing an electrical connection in order to earth an electrical device.



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Claims searched: 1 to 14

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## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): C3K KHA KMA

Int Cl (Ed.7): C08K 3/02, 3/08

Other: ONLINE: EPODOC, JAPIO, WPI

### Documents considered to be relevant:

| Category | Identity of document and relevant passage   | Relevant to claims                  |
|----------|---|-------------------------------------|
| X        | EP 0874024 A1 KAWASAKI STEEL see the claims and page 5, lines 38 to 43, Table 1 and page 15, lines 3 to 9 | 1,2,3,4,5, 5,6,7,8,10, 11,12,13, 14 |
| X        | EP 0099573 A1 DIAMOND SHAMROCK see page 1, lines 7 to 15, and Examples 5 and 6                            | 1,4,5,6,8, 10,11,12,1 3, 14         |
| X        | WO 88/06342 A1 GENERAL ELECTRIC see the Examples  | 1,2,3,6,8, 10,11,12,1 3,14          |
| X        | US 5240645 A UNITED TECHNOLOGIES AUTOMOTIVE see the Example   | 1,2,3,4,5, 8,9,10,11, 13,14         |
| X        | US 4678602 A DAICEL see column 2, lines 50 to 55, column 3, lines 43 to 52, and Examples 1 to 4           | 1,2,3,4,5, 8,10,11,12, 13,14        |
| X        | US 3632792 A MONSANTO see Example 2   | 1,2,3,4,5, 6,7,8,11,1 2,13          |

X Document indicating lack of novelty or inventive step  
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

& Member of the same patent family

A Document indicating technological background and/or state of the art.  
P Document published on or after the declared priority date but before the filing date of this invention.  
E Patent document published on or after, but with priority date earlier than, the filing date of this application.